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Honey production potential of the honey bee (*Apis mellifera*) in Karak and Kohat, Pakistan

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Abstract
Honeybees are present in all parts of the world except extreme Polar Regions and are considered among social insects living in the form of colonies. Colony is made by different types of individuals like drones, workers and queen performing various activities within a colony. The current study was conducted to find out amount of honey production in the bee farms located in districts Kohat and Karak during 2011-2014 as these districts are ideal localities for the rearing of honey bees for honey production. These two districts having rich honey bee host plants particularly *Ziziphus jujuba (*Berry) and *Acacia modesta* (Palosa) are present in abundance.
Results show that the highest honey production was found in Terawal Banda (5.20 kg/colony) followed by Hassan Banda (5 kg/colony) and Darmalok (5.08 kg/colony) while lowest range of honey production (2 - 3.8 kg/colony) was observed in various localities in district Kohat during 2011-2014. Similarly, in district Karak, Ahmad Abad was acknowledged the maximum honey producing area as in this zone considerable amount of honey production was reported. Interestingly the increase in honey yield was observed higher in district Karak as compared with district Kohat during 2011-2014. Overall annual honey productions seem to be not uniform in all the regions in two districts at the time of the study.
The two studied areas (Karak and Kohat) in north-west of Pakistan have a great potential of honey production. Additionally, introducing the modern apicultural techniques can increase the average honey production in the mentioned areas.

Keywords: Honey bees, colonies, honey, beer plants

1. Introduction
Honey is considered as sweetest and natural food product obtained mostly through beekeeping farms and also obtained wildly [1]. Honey is made up of different nutrients, ions and vitamins. In the same way, it is a valuable nutritive food supplement containing various types of sugar molecules, proteins, amino acids, minerals. Honey has been used as usual folk drugs and apitherapy for treatment, healing of wounds and a rich source of energy [1-4]. Momentous antimicrobial activities of the processed honey and unprocessed honey collected samples from the north-west areas of Pakistan a moment ago have been investigated [5-8].
In Pakistan, four species of honeybees are present. The honeybee have the strong affinity towards honey production and the dispersal of seed are also know for pollination services and the most important function is their crop pollinator [9, 10]. There are three honey bee species (*Apis florae*, *Apis dorsata* and *Apis cerana*) as they are the most important crop pollinator which are indigenous and considered as the native species of Pakistan. One (*Apis mellifera*) is migrated from Russia and Australia during 1979 [11]. The improved qualities and quantities of fruits and vegetation, production of standard seeds and highly modified crops was the performance of *Apis mellifera* species through pollination in the selected study areas [12]. These regions have a key role in honey agro-food chain so since few years honey has become one of the most commercial agricultural products for trade in Pakistan [13-17].
So, to study the honey production potential in the study area the current research was carried out. Awareness of modern apicultural technology may accelerate the current honey yield in bee farms located in the study areas.

2. Materials and Methods
2.1. Study Area narration
The present study was carried out in two districts; Karak and Kohat, of KP to identified the total number of honeybee colonies and average honey productivity from each colony during

2011-2014. The latitudes of district Karak are from 70-40' - 71 '30' north and their longitudes 32'-48' to 33'-23' from east. These areas are mostly arid that acquires a huge land for bee parks during berry and Palosa flowering seasons which are the native plants of the mentioned district. The visitor beekeeping performs their activities are carried out from the month August – October (Figure 1). The land available for cultivation is only 3.32%. Banda Daud Shah and Takhte-e-Nasratti are the two main sub-divisions of Karak. 12 km from Kohat, 56 km from Bannu its headquarter Karak town is situated. Peshawar and D.I. Khan high way, it is nearly 24 km away eastward [18, 19].

Similarly district Kohat is a major berry honey bee plants growing area of the province (Table 3) located at an elevation of 489 meters (round about 1,604 ft) and includes a region of 2,545 Km^2 (983 square miles). Kohat contains an intermediate sized township of Khyber Pakhtunkhwa, Pakistan. Kohat Division has three distinct ecological zones. To the west and northwest in Parachinar and the Orakzai and Federally Administered Tribal Areas (FATA) winters are severely cold, summers are mild and peaks remain snow-covered (Figure 2). In the south lies a vast sandy terrain adjoining mountains with stony soil typical vegetation includes *Zizyphus* spp. and other xerophytes [20] (Table 3). Additionally, this district has potentials with vast pollen and nectar resources utilized by modern beekeeping activity to undertake (Figure 4).

The current study was totally based on the questionnaires. The samples of questionnaires were distributed among the honeybee keepers in the already discussed area. Information was gathered from each site by using a questionnaire and from the local experienced people through personal interview. Questionnaire also contain the questions which were food in case of emergency, diseases during their egg hatching season, breeding potential and the accumulation of plant juice etc the study was conducted by frequent surveys in the months of July to October during 2011 to 2014 [21] and collected data was analyzed using MS Excels 2007.

3. Results

3.1 Colonies and honey production from district Kohat

In 2011 the honey production with unit kg per colony was obtained and showed that maximum honey production was observed in Hassan Banda (5 kg) as compared to Billi Tang (2 kg), Darmalok (2 kg) and Terawal Banda (2 kg) (Table 1). Darmalok produce the highest number of colonies while Bharati Banda has lowest. Interestingly, premier colonies and honey production were calculated in Hassan Banda (3.8 kg). Comparatively, the less production of honey per colony was measured in Shakardara (3 kg) during 2012 (Table 1). During 2013 the highest number of colonies was noticed in Billi Tang while the lowest colonies were in Bharati Banda. Ghoor Zandi was recorded in the highest honey production (4.29 kg) per colony while Shakardara (2 kg) with the lowest production. Considerably, Shakardara showed the lowest honey produced compared with other areas of the same district. Interestingly, highest number of colonies and honey production were observed in Billi Tang while per colony the highest honey production was in Ghoor Zandi and the lowest were in Shakardara (Table 1). In 2014 greatest figure of colonies were recorded in Siyab while lowermost were in KDA and the highest productivity was found in Terawal Banda (5.20 kg) while lowest in Razgyer Banda (3.12 kg) 2011 - 2014.

3.2 Colonies and productivity from district Karak

During the year 2011 Maximum productivity per colony was showed by Saber Abad (3.0 kg) whereas Teri (2.1 kg) and Chokara (2.1 kg) has the lowest one (Table 2). The maximum number of colonies was observed in Teri but less was in Warana. In 2012 it was observed that significant amount of production in additional and described regions of district Karak. In the same way, the planned per colony yield of honey was recorded higher in Saber Abad (3.5 kg) while lower in Latamber (2.5 kg) (Table 2). Banda Daud Shah (3.5 kg) demonstrated the increased production of honey, so therefore Amberi Kala (2.3 kg) was an area of decreased productivity.

(Table 2).Ahmad Abad (5.3 kg) amount of honey production was observed while lowest in Warana (3.3 kg) compared to the other areas of district Karak during 2014 (Table 2). Overall annual honey productions seemed to be not uniform in all the regions in two districts during the survey period. However, rises in honey production is surely associated with climatic conditions and honey bees management practices particularly in rich bee host plant areas. Total honey production from Districts Kohat and Karak. The graphical presentations show the honey production in unit kg (Figure 4. 3).

Fig 4.1: Map of the study area Karak

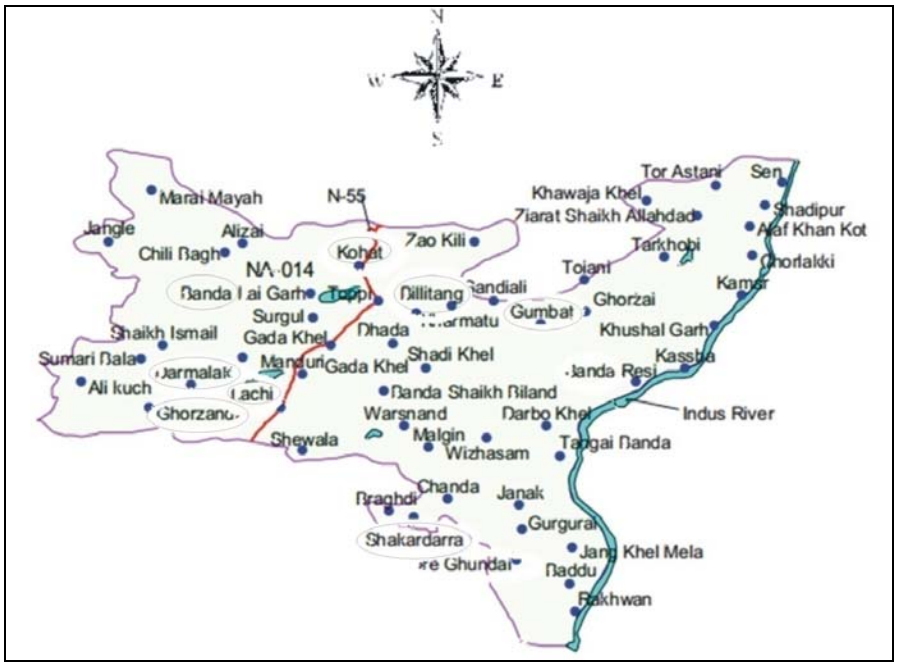

Fig 4.2: Map of the study area Kohat

Table 1.1: The sum of honey production in district Kohat during 2011-2014

S. No.	location	2011	2012	2013	2014
		Prod(kg)/Col.	Prod(kg)/Col.	Prod(kg)/Col.	Prod(kg)/Col.
1.	Shakardara	4.00	3.00	1.06	4.25
2.	Lachi	3.01	3.20	2.94	4.60
3.	Fetah Banda	4.00	3.50	3.80	5.00
4.	Hassan Banda	5.00	3.80	4.00	4.81
5.	Terawal Banda	2.00	3.10	2.80	5.20
6.	Darmalok	2.00	3.30	4.00	5.08
7.	Ghoor Zandi	2.50	3.60	4.29	4.00
8.	KDA Kohat	3.50	3.11	4.00	4.91
9.	Billi Tang	2.00	3.00	2.90	4.24
10.	Razgyer Banda	3.30	3.00	3.50	3.12
11.	Siyab	2.30	3.00	3.40	3.49
12.	Bharati Banda	3.01	3.25	3.32	4.14
13.	Gumbat	3.00	3.07	4.00	4.04

Table 1.2: Overall honey production in district Karak in 2011-2014

S. No.	Areas	2011	2012	2013	2014
		Prod(kg)/Col.	Prod(kg)/Col.	Prod(kg)/Col.	Prod(kg)/Col.
1.	Chokara	2.1	2.6	3.0	4.5
2.	Ahmad Abad	2.2	3.0	2.5	5.3
3.	Warana	2.2	3.1	3.2	3.3
4.	Gardi Banda	2.4	3.1	3.2	4.4
5.	Amberi kala	2.6	3.3	2.3	4.3
6.	Takhte-e-Nasratti	2.3	2.7	3.2	5.0
7.	Saber Abad	3.0	3.5	3.4	4.0
8.	Banda Daud Shah	2.8	2.8	3.5	4.4
9.	Latamber	2.6	2.5	3.1	4.3
10.	Teri	2.1	2.6	3.2	4.5
11.	Bhader Khel	2.3	3.1	3.2	4.2

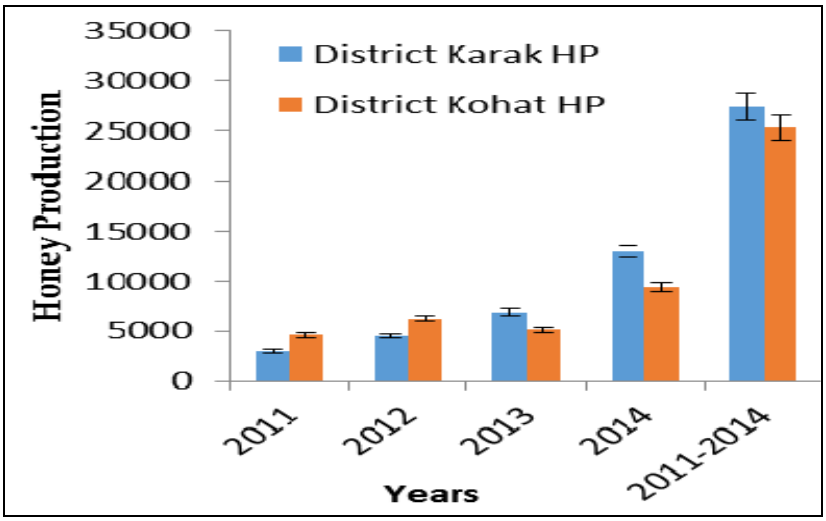

Fig 4.3: Total honey production from Districts Kohat and Karak.

Table 1: Significant honeybee vegetation in study areas

S. No.	Vernacular name	Scientific name	Family	vegetation	Shrubs & herbs	Flowering seasons
1.	Sreen	*Albizia lebbeck*	Mimosaceae	Tree	------	April~May
2.	Bera	*Ziziphus jujuba*	Rhamnaceae	Tree	------	Spring
3.	Palosa	*Acacia modesta*	Mimosaceae	Tree	-------	March~April
4.	Shawa	*Convolvulus arvensis*	Papilionaceae	Tree	--------	Spring
5.	Sponda	*Peganum harmala*	Zygophyllaceae	------	Herb	
6.	Gurgura	*Monotheca buxifolia*	Sapotaceae	Tree	---------	March~April
7.	Spin Shatut	*Morus alba*	Moraceae	Tree	-------	March~April
8.	Kirra	*Capparis decidua*	Capparidaceae	Tree	--------	
9.	Pyazakay	*Asphodelus tenuifolius*	Asclepiadaceae	-----	Herb	
10.	Gandarai	*Rhazya stricta*	Apocynaceae	------	Shrub	Sep.~Dec
11.	Kikar	*Acacia nilotica*	Mimosaceae	Tree	------	April~May
12.	Sada Gulab	*Rosa indica*	Rosaceae	-----	Shrub	Throughout year
13.	Angur	*Vitis vinifera*	Vitaceae		Shrub	Feb.~March
14	BadaBera	*Zizyphus oxyphylla edgew*	Rhamnaceae	Tree	-----	Spring

Fig 4.4: A movement of a colony inspection at district Kohat.

4. Discussion

Honey bees are considered as societal insects, reside in the territory recognized as colony, comprises of individuals in which drones, workers, and queen are involved. The participant performs a particular task inside the colony activities. A solitary queen is an obligatory and most important member of colony [22].The current study was carry out in two districts of Kohat division, district Karak and district Kohat along the different localities of the same districts during 2011-2014 to be familiar with the entirety colonies, diverse sites and to discover the honey production with respective season. According to the recent results in district Kohat the maximum number of honey production per colony was observed in Hassan Banda, Ghoor Zandi and Terawal Banda It may possibly due to ecological issues and causes including high temperature, moisture in air, environmental pollutions and a huge amount of rainfall which were not complimentary to the bee rearing, their developmental stages and also influence the efficiency rate of honey. According to Crane [23], Ayalew [24] and EARO [25] the most important task for beekeeping in district Karak include the subsistence and plenty of honeybee, accessibility of potential flowering season of plants, sufficient means of water for bees, beekeepers' experience and practices, socio-economic value of honey and marketing situation of bee products.

In one description which was recorded in 2007 that the total numbers of colonies in the Republic of Serbia were 267000 and the produced quantity of honey was 13 kg per colony. 48311 colonies, 1.74% bee are able under the trained and well experienced beekeepers. Skilled and practiced beekeepers can generate more honey as contrast to the hobbies and unskilled beekeepers. The study has exposed that one thousand (1000) ton honey will be produced by the professional and well educated beekeepers and 28% of the total honey contributes to Serbia [26]. Therefore, know-how and skillfulness of beekeeper are extremely significant aspect in the manufacturing and collection of honey. However, the knowledge of modern beekeeping and occurrence of pest and diseases are most important constrains in the studied areas where low honey production was observed. Kinati *et al*., (2012) also noticed that decrease in honey production in Ethiopia is due to the untrained beekeepers and high load of pests and parasites [27, 28].

In the present study, the highest honey production per colony was noticed in Saber Abad, Banda Daud Shah and Ahmad Abad while the lowest production was in Chokara, Teri, Latamber, Amberi kala and Bhader Khel respectively. Favorable environmental conditions in Nepal correlated in increase annual production of honey (50 to 70 kg per colony) [29]. Using traditional techniques in beekeeping industries in northern Ethiopia decrease the production of honey up to 13 kg honey per colony. On the other hand, a significant increase in honey production up to 30 kg/colony per annum in the same areas were observed by the efforts of trained beekeepers [30]. Majority of beekeepers in the current study areas are afghan migrants, strictly follow the old method of bee farming therefore since 2011 to 2014, no huge increase occurred both in honey production and colony size. This may suggest that comprehensive knowledge in beekeeping activity followed by modern honey processing techniques boost the production of export quality honey in North West Pakistan.

IPMS reported and analyzed [31] the results and also discussed the major problems in beekeeping arise from bee character or environmental factors that are beyond the control of the beekeepers, the others problems mentioned by the beekeepers were poor marketing infrastructure and storage facilities. As a result, be lacking of knowledge attack of pests and predators were found to be the top two challenges for beekeeping in the area. Nuru [32] stated that the Bee mites, Wasps and Birds considered as the main predators for honeybees. The high rainfall in the area also disturbed the rearing and honey production. The reason of their high migration during the months from March - May could be associated with lack or insufficiency of bee forage in the area (personal remark).

The total honey production of Ethiopia is estimated up to 24000 metric tons; only a small amount of this is marketed. Besides poor marketing conditions the main reason is that about 80 per cent of the total Ethiopian honey production supplied in to the local honey wine, which is consumed as national drink in large quantities [33]. The honey industrious rates were 30 kg per colony, following the contemporary and advanced procedures and with the assessment of well-trained production methods while 13 kg honey per colony was produced by tradition [30]. 119428 colony of *Apis cerana* were accomplished in Nepal and the production achieved through past extraction method. Among these bees 101684 were monitor bees and 2.8 kg production occur per colony while 6.8 kg per colony were observed in middle part of Nepal, in the same way, in the western area of Nepal 3.4 kg were produced and 4.6 kg of honey were produced in the mid-western part of Nepal. The honey produced in far western area of Nepal was 5 kg reliant on the vicinity of the quarter. Though, the extreme annual production of honey in Nepal was 50 to 70 kg per colony is due to the environmental aspects [29].

Maximum honey production was interconnected with sufficient food stuff and sound qualified beekeepers. A study performed by Tsutsumi [34] at the diverse zone of United state Those 2443,000 colonies of *Apis mellifera* species was producing 27.5 kg honey production per colony were showed. This conclusion are elevated than the current results and the influences are that the beekeepers follow supplementary advanced skill of honeybee rearing, safety measurement, availability of extra balance diet and a reduced amount of polluted ecological condition accompanied to its higher results.

An appropriate study documented by Shah [35] in Bangladesh that reported 30 - 40 kg of honey per colony was manufactured on annual base. Although, the amount of honey in Bangladesh is greater than the production of Nepal but the excellence of the honey is inferior as compared to honey of the other regions of the world. In Pakistan, the valley of Chitral produced 1332 kg of honey taken out from single household bee hive in Kalash valley per annum. From the whole amount of honey, 130 kg were produced from the various types of vegetation nectars of Chitral. With the similar situations Chitral tree-plants consists of the most increased size in length and wild flowering trees. The ecological changes of the area also show positive and proper amount of honey production. The restricted beekeepers extract the honey from the hives, by means of local and modern method of extraction. Using these techniques in honey collection the productivity rate is decreasing every day due to depletion and reduction. The honeybee loss may occur due to certain factors. In Chitral, local acquired rate of honey collected from 400 – 500 per kg during 2005. Partly of the total honey was purchased in the native markets of Chitral while left over honey delivered in the nationalized and intercontinental markets [36].

5. Recommendation

During the current investigation efforts it was distinguished that, for the annihilation of honeybee diseases no appropriate remedial support was accessible that is why an enormous thrashing happened. Wasps and mites also severely affect them. The beekeepers were ignorant from the suitable and proper feeding necessity of honey bee during their propagative periods. The beekeepers were not recognizable with the recent procedure of beekeeping. As a result they don't achieve the preferred annual production of honey. Weak relations of beekeepers with supervisors, entomologists and farming and agricultural sectors were also an issue of concerning.

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